MANCHESTER AND SALFORD

SANITARY ASSOCIATION.

REPORT OF THE SUB-COMMITTEE

APPOINTED TO INVESTIGATE

The Action of Water upon Lead.

PRESENTED TO THE GENERAL COMMITTEE, NOVEMBER 1, 1861.

MANCHESTER:

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Mr. C. G. CARTLEDGE, Secretary,

At the Offices of the Association, 33, Pall Mall,

(Near to the Bank of England.)

The Committee of the Manchester and Salford Sanitary Association deem it their duty to publish the following important Report from one of their Sub-Committees. In doing so, they have no other desire than to promote the investigation of truth, and they would especially urge on all persons using water which passes through lead pipes, the importance of attending to the closing advice of the report; viz,—never to use water for dietary purposes which has remained even for a few hours in the pipes.

Report of the Sub-Committee appointed to investigate the Action of the Water, supplied by the Manchester Corporation, upon Lead.

To the Committee of the Sanitary Association.

Gentlemen,

We have the pleasure of laying before you the results of a long series of experiments, undertaken with the view of ascertaining whether the water supplied by the Corporation of this city, exerts any, and what, action on lead piping.

The Sub-Committee are greatly indebted to Dr. Calvert for the valuable assistance rendered by him in carrying out the experiments at the Laboratory of the Royal Institution.

The lead piping used for the experiments was obtained from two well known firms, by whom large quantities of the piping used in Manchester have been supplied.

A new pipe of common lead was fitted up, through which the whole of the water used in the Laboratory flowed.

To determine the action of water on this pipe, samples of water were taken each morning after it had remained in the pipe all night, and other samples were taken in the evening after the pipe had been in ordinary use during the day, so as to test the influence of the water upon the lead when merely passing through the pipe, or when only remaining therein during short intervals.

These experiments were continued from July 6th to August 28th, 1859, a period of nearly 8 weeks. The quantity of lead found in the water at the commencement was very considerable, gradually diminishing, until, at the end of six weeks, no trace could be discovered in the water drawn in the evening, but after the water had been allowed to remain in contact with the pipe for 12 hours, a considerable quantity of lead was found.

It was deemed advisable to determine, with greater precision, the amount of lead in solution in the water. For this purpose, a solution of acetate of lead was used as a standard, containing a thousandth part of a grain of lead in each division of an alkalimeter.

The method of testing employed was as follows:—

A known volume of the water in which the quantity of lead was to be determined, was acidified with acetic acid, and saturated with sulphuretted hydrogen, the result being to give the water a dark tint, varying, in intensity, with the quantity of lead in solution. An equal volume of distilled water was also acidified and saturated with sulphuretted hydrogen. Into this last liquor a quantity of the standard solution of lead was poured, until the saturated distilled water acquired the same depth of tint as the water to be tested. The quantity of standard liquor required was then read off, and the amount of lead per gallon calculated.

By this means the following results were obtained:—

1859.						
August	30.	Morning,	.040	grain per gallon.	Afternoon,	none.
,,	31.	,,	.040	,,	,,	,,
September	1.	,,	.040	,,	,,	,,
,,	3.	,,	.066	,,	,,	,,
,,	4.	,,	.040	,,	,,	,,
,,	5.	,,	.040	,,	,,	,,
,,	6.	,,	.033	,,	,,	,,
,,	7.	,,	.033	,,	,,	,,
,,	8.	,,	.025	,,	,,	,,

September	10.	Morning	.033	grain	per gallon..	Afternoon,	none.
,,	11.	,,	.020	,,		,,	,,
,,	12.	,,	.020	,,		,,	,,
,,	13.	,,	.020	,,		,,	,,
,,	14.	,,	.020	,,		,,	,,
,,	15.	,,	.020	,,		,,	,,
,,	17.	,,	.033	,,		,,	,,
,,	18.	,,	.020	,,		,,	,,
,,	19.	,,	.020	,,		,,	,,
,,	20.	,,	.020	,,		,,	,,
,,	21.	,,	.033	,,		,,	,,
,,	22.	,,	.033	,,		,,	,,
,,	24.	,,	.040	,,		,,	,,
,,	25.	,,	.033	,,		,,	,,
,,	26.	,,	.033	,,		,,	,,

After an interval of about 7 months the experiments were again proceeded with. During that period a portion of the supply pipe had been left full of water, with the view of ascertaining what effect would be produced by water remaining stagnant in pipes for a long period, the pipes being again regularly used, as is often the case after a house has been unoccupied and then becomes tenanted.

The stagnant water was drawn off, and fresh water allowed to flow through, for the purpose of cleansing the pipes.

The water was then allowed to remain in the pipes for intervals of 24 hours or more, as may be seen from the following table, and was tested on the morning of each of the days named. We then obtained the following results:—

1860.

Water in pipe	from	April	24	to	April	25,	contained	.10	gr. per gal.
,,		,,	25	,,	26	,,		.10	,,
,,		,,	26	,,	27	,,		.10	,,
,,		,,	27	,,	29	,,		.25	,,
,,		,,	29	,,	30	,,		.10	,,

Water in pipe	from April	30	to May	1	containing	.10	gr. per gal.
,,	from May	1	,,	2	,,	.10	,,
,,	,,	2	,,	9	,,	.20	,,
,,	,,	9	to June	1	,,	.25	,,
,,	from June	1	,,	3	,,	.10	,,
,,	,,	3	,,	4	,,	.05	,,
,,	,,	4	,,	6	,,	.10	,,
,,	,,	6	,,	7	,,	.05	,,
,,	,,	7	,,	8	,,	.05	,,
,,	,,	8	,,	10	,,	.10	,,
,,	,,	10	,,	11	,,	.05	,,
,,	,,	11	,,	13	,,	.05	,,
,,	,,	13	,,	14	,,	.05	,,
,,	,,	14	,,	15	,,	.05	,,
,,	,,	15	,,	17	,,	.05	,,
,,	,,	17	,,	20	,,	.10	,,
,,	,,	20	,,	22	,,	.10	,,

The marked increase of lead indicated in these results over those of the previous experiments, tends to show that the action of stagnant water is constant, and so far corrodes the lead, that when the pipe is again brought into ordinary use, it yields to the water which passes through a certain portion of the lead compound which has been produced during the long contact of the water with the pipe.

We also deemed it advisable to ascertain the action of the water on various kinds of supply pipes which have been used, or have been proposed to be used, for conveying water into dwelling-houses. With this view the following plan was adopted by the Committee:—

Four varieties of half-inch piping, each 18 feet long, and having a tap at each end, were connected with the service pipe, and each coiled and enclosed in a small barrel fastened with a padlock, so as to preclude the possibility of any tampering with the experiments.

The four pipes taken were,—

No. 1. Extra tinned lead piping.

No. 2. Ordinary tinned lead piping.
No. 3. Best, or Virgin ,,
No. 4. Common ,,

The following are the results of the experiments on these pipes :—

On the 13th and 14th July, 1860, the quantity of lead found in the water taken from each of these pipes was very large. The experiments were suspended until the 23rd July, when they were repeated. The quantity was then found to be very considerable, but gradually diminished to the 2nd August.

The action of water on these various pipes was so very marked, that it was deemed advisable to determine the quantity of lead taken up and held in solution. On the 2nd August a fresh supply of water was introduced into each pipe, which remained there until the 21st of the same month, when samples were drawn for analysis, and the following are the results :—

No. 1. Extra tinned piping .522 gr. per gallon.
No. 2. Ordinary ,, ,, .364 ,,
No. 3. Best lead ,, 1.369 ,,
No. 4. Common ,, .510 ,,

The pipes were cleaned out for another analysis on the 22nd October, and refilled with fresh water, and samples drawn on the 9th November, which gave the following results :—

No. 1. Extra tinned piping .580 gr. per gallon.
No. 2. Ordinary ,, ,, 1.019 ,,
No. 3. Best lead ,, .981 ,,
No. 4. Common ,, 1.200 ,,

These results were obtained by precipitation of the lead in the form of sulphuret of lead, and weighing the precipitation in the form of sulphate of lead.

This process of analysis being long and tedious, the standard liquor, before described, was used in the remaining experiments, which were resumed in December, the water remaining in the pipes as before.

	Extra tinned.	Ordinary tinned.	Best lead.	Common lead.
Dec. 18.	.10 gr. ℔ gal.	.12 gr. ℔ gal.	.12 gr. ℔ gal.	.12 gr. ℔ gal.
„ 19.	.10 „	.12 „	.12 „	.14 „
„ 20.	.10 „	.12 „	.12 „	.12 „
„ 22.	.06 „	.08 „	.08 „	.08 „

With the view of testing whether the various denominations of piping always yield results similar to those before-mentioned, we obtained the same variety of piping from another manufacturer. The following are the results obtained in 1861 :—

Water in pipes from			No. 1.	No. 2.	No. 3.	No. 4.
April 24	to April	25	.10	.20	.25	.20
„ 25	„	26	.10	.20	.25	.20
„ 26	„	27	.15	.20	.20	.20
„ 27	„	29	.20	.25	.30	.30
„ 29	„	30	.10	.15	.15	.15
„ 30	to May	1	.10	.20	.25	.20
May 1	„	9	.20	.40	.45	.60
„ 9	„	10	.20	.20	.35	.40
„ 10	„	14	.40	.36	.33	.34
„ 14	to June	1	.64	.72	.84	.84
June 1	„	3	.32	.48	.32	.48
„ 3	„	4	.24	.32	.24	.32
„ 4	„	6	.32	.48	.32	.48
„ 6	„	7	.24	.32	.24	.32
„ 7	„	8		.16	.16	.16
„ 8	„	10	.16	.16	.16	.16
„ 10	„	11	.16	.24	.16	.24
„ 11	„	13	.16	.24	.16	.24
„ 13	„	14	.16	.16	.16	.16
„ 14	„	16	.16	.16	.16	.16
„ 15	„	17	.24	.32	.32	.32
„ 17	„	20	.32	.32	.32	.32
„ 20	„	22	.32	.32	.32	.32

So far, as relates to the deletereous effects on the several pipes, the results obtained with this series, corroborate, generally, those obtained with the first series, but there are some remarkable variations in the quantity of lead at various times, which appears to indicate a variation in the quality of the water.

In reference to the question under consideration, it is important to know what is the quantity of lead contained in water which has been proved to produce absolute illness requiring medical treatment, and, in 5 cases recently tested, the following results have been obtained:—viz., 0.1069—0.298—0.123—0.030, and 0.10 grain per gallon respectively.

These quantities, it will be observed, do not exceed those found in the other waters used in the experiments recorded above.

The experiments on which we now report, carried on during a period of more than 2 years, and in which more than 300 samples of water have been tested, prove,—

1st. That the Manchester water does act on lead pipes to a very serious extent.

2nd. That that action continues for a much longer period than is generally supposed.

3rd. That when the water remains stagnant in the pipes, it not only becomes highly charged with the dangerous poison, but a coating is formed on the inner surface of the pipes, which coating is subsequently detached by the water passing through, and which it impregnates with lead.

4th. That even after pipes have been used a considerable period, the quantity of lead contained in the water which has remained 24 hours in the pipe, is quite as great as in cases where serious effects have been known to ensue to parties using the water.

5th. That the practice of lining lead pipes with tin affords little, and only temporary, protection, and is of no practical value.

Bearing in mind that lead is a cumulative poison, and that water containing it may be used for a considerable time, and the foundation be laid for great suffering and physical injury, before the symptoms become so marked as to justify a medical man in pronouncing the case to be one of lead poisoning; the discovery and adoption of pipes for domestic supply, which could not be productive of this evil, is of the greatest moment, especially to our densely populated labour districts.

The first step towards remedying the evil, is a thorough conviction of its existence, and of the serious results which may follow from disregarding its importance.

Let the community at large be convinced on these points, and it is most probable that an efficient remedy would be discovered, more especially if the corporation would offer, to parties engaged in the necessary pursuits, some inducement to produce a pipe, economical in cost, easy of application, and on which the water would not act prejudicially.

The subject is one of great importance, and, in the opinion of your Sub-Committee, deserves further and careful investigation.

So long as lead pipes are used, it is of great importance that parties should not use, for dietary purposes, any water which has been allowed to remain in the pipes for even a few hours.

C. E. CAWLEY, Chairman.

October 28th, 1861.

Powlson and Sons, Printers, Bow Street, John Dalton Street, Manchester.